Basic Spacetime and Astrophysics for Beginners (an introduction)

An introduction to the beginning of the concept of spacetime

In 1905, Einstein introduced a completely new way of thinking about gravity and Astrophysics in his paper of special relativity. Today, I would like to explain to you what he intended to say in his two papers in special and general relativity. Let us first start by understanding the concept of a "perspective" in the context of Physics.

The concept of a 'perspective'

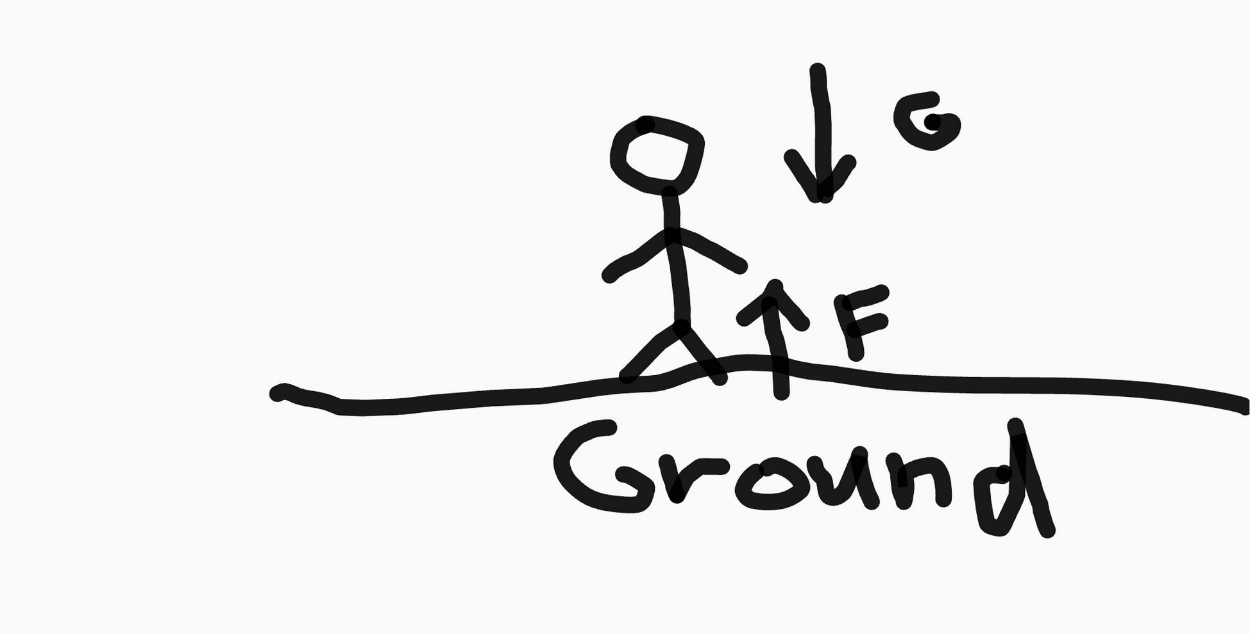
A perspective in physics is just the same as it is in real life. It simply corresponds to how you, a body, or another person sees what is happening, for example, if you jump off a building, you would see everything accelerating (increasing in speed over a distance) at 9.8 meters per second of increase in one second. But, to a person standing away from you at say, a restaurant, they would see you accelerating at the same speed, but downwards. In this situation, you are termed as an inertial observer while the person that was watching you from the restaurant is termed as an external observer, self-explanatory, right.

Gravity, what is it?

To understand what gravity is, we first must understand what spacetime is. Spacetime can be imagined as a thin sheet, of sorts, that spreads out to cover the whole of the Universe. Gravity is simply a way to represent that a mass that is present on this sheet is bending the sheet out, creating some degree of an indent in this sheet, so another mass on this sheet, when close enough, "falls into" this indent, causing it to be attracted to the bigger mass. Of course, the smaller mass does also curve spacetime, but the curve it forms is smaller than the one made by the bigger mass, hence, it gets attracted to the bigger mass. Now, you may think that gravity is a force, and in Newtonian physics, it is, but in Einsteinian physics, as previously mentioned, gravity is just the curvature of spacetime. Gravity is not a force. Gravity is just an illusion made by our perspective and the human brain and its method of processing its surroundings. In reality, the entire Universe is constantly accelerating upwards at 9.8 meters per second per second. This is shown by the example given above, with the man falling off the building, during the short period while he has not fallen down to the ground, he is an inertial observer, he sees the true picture. He will see the entire world accelerating upwards at 9.8 meters per second per second. As he is falling, he is an inertial observer and the people on the ground are external observers. But why does this happen?

Let us understand with a simple example

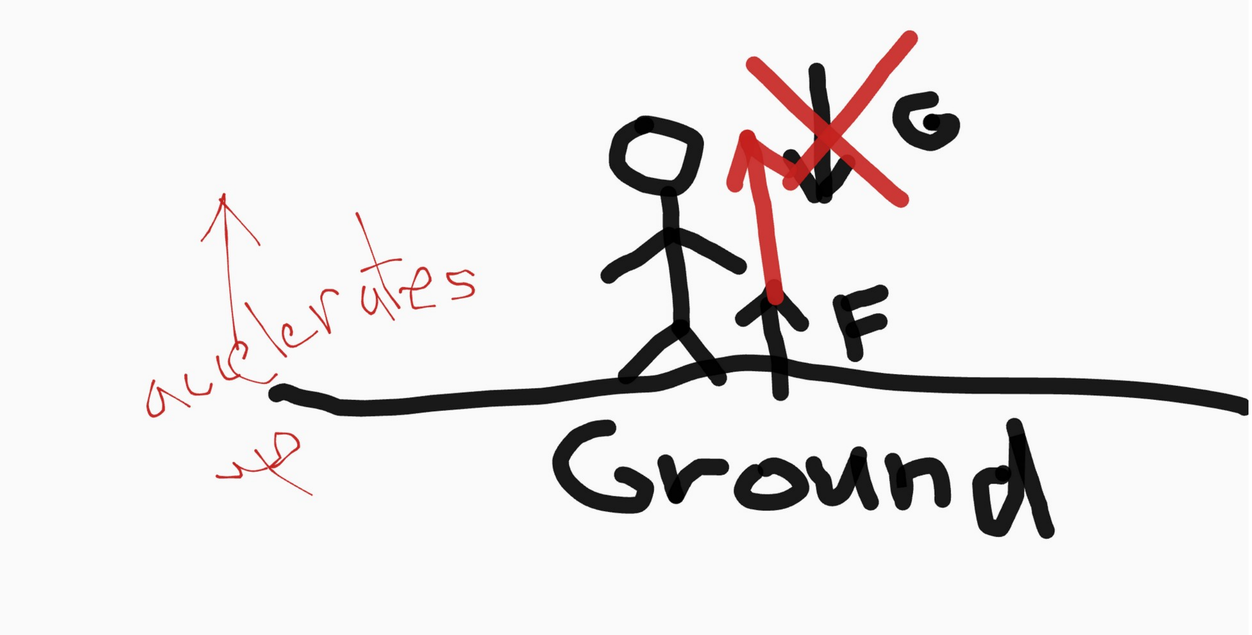
In Newtonian physics, a diagram denoting all the forces on the person would look like this



Here, the letter G represents gravity as a force in Newtonian physics. And the letter F represents Normal Force, which is a force caused due to Newton’s third law. As some of you may know, Newton’s third law states that every action has an equal and opposite reactions, when you are pushing on the ground downwards (as weight is a force that your body applies on the ground),

Newton’s third law states that there should also be an equal and opposite reaction, and there is in the form of Normal Force. Hence, Normal Force applies force back on your body when you compress the ground when you apply weight on the ground.

Hence, here gravity is denoted as a force by Newton and his idea of physics. But, according to Einstein and his idea of physics calls for a completely different story. In Einsteinian Physics, gravity is not a force, but simply the curvature of spacetime. Hence, gravity is no longer combatting normal force, causing it to push EVERYTHING upwards. Here is a diagram: (on the next page)



Now, you may think, that when gravity is not a force, why are we still stuck to the ground. Well, as the Earth and the universe accelerates upwards, due to Newton’s third law again, states that for every action, there is an equal and opposite reaction. Now, as the Universe moves upwards, a reverse-acting force pushes us towards the ground.

Now, that was the basic intro and in volume 2, this knowledge will be built upon to make an even better interpretation of Physics and Spacetime

For now, bye!